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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification 6 : B32B 27/12, 31/00, A61F 13/15, D04H 13/00 — A1

(11) International Publication Number: WO 98/28134

(43) International Publication Date: 2 July 1998 (02.07.98)

(21) International Application Number: PCT/US97/23145

(22) International Filing Date: 11 December 1997 (11.12.97)

(30) Priority Data:

| | | |
|---|---|---|
| 08/770,857 | 20 December 1996 (20.12.96) | US |
| 08/837,676 | 22 April 1997 (22.04.97) | US |

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(81) Designated States: AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, CA, CH, CN, CU, CZ, DE, DK, EE, ES, FI, GB, GE, GH, HU, ID, IL, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MD, MG, MK, MN, MW, MX, NO, NZ, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, UA, UG, UZ, VN, YU, ZW, ARIPO patent (GH, GM, KE, LS, MW, SD, SZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, CH, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, ML, MR, NE, SN, TD, TG).

**Published**

*With international search report.*

*Before the expiration of the time limit for amending the claims and to be republished in the event of the receipt of amendments.*

(54) Title: LAMINATION OF BREATHABLE FILM USING A RUBBER-COVERED ANVIL ROLL

(57) Abstract

The present invention relates to a process for producing an improved film/nonwoven laminate from a fibrous nonwoven web and a polymeric film wherein the nonwoven web and polymeric film are bonded together by passing the nonwoven web and the polymeric film through the nip between two rolls. One of the rolls is in contact with polymeric film. This roll has a surface that is made from a soft material that deforms under nip pressure.

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# LAMINATION OF BREATHABLE FILM USING A RUBBER-COVERED ANVIL ROLL

## FIELD OF INVENTION

The present invention relates to a process for laminating breathable film using an anvil roll covered with a soft material. The invention further concerns the product produced thereby.

## BACKGROUND OF THE INVENTION

The present invention relates to a breathable film/nonwoven laminate having improved toughness (elongation) and greater retention of barrier properties. The present invention also relates to the process of producing the same using an anvil roll covered with a soft material.

Laminate materials have a wide variety of uses, especially in the areas of absorbent articles and disposable items. As used herein, the term "absorbent articles" refers to devices which absorb and contain body exudates and, more specifically, refers to devices that are placed against or in proximity to the body of the wearer to absorb and contain the various exudates discharged from the body. The term "absorbent articles" is intended to include diapers, training pants, incontinence devices and the like. The term "disposable" is used herein to describe absorbent articles not intended to be laundered or otherwise restored or reused as an absorbent article.

Film/nonwoven laminates may be produced using thermal point bonding. Traditionally thermal point bonding entails passing the webs that are to be bonded together through the nip of two steel rolls. Generally, one of the steel rolls is engraved, or embossed, with a pattern. This roll is known as the "pattern roll." The non-engraved roll is known as the "anvil roll." During the lamination process, the pattern on the pattern roll is imparted to the laminated web. Use of steel anvil rolls tends to result in severe deformation of the

nonwoven fibers, resulting in a weak laminate.

A need, therefore, exists for a method of producing a film/nonwoven laminate having improved toughness without causing severe deformation to the nonwoven fibers.

SUMMARY OF THE INVENTION

It has now been found that lamination of breathable film using an anvil roll covered with a soft material produces laminates without the severe deformation of the nonwoven web that often results from using two steel rolls. The reduced deformation of the nonwoven web results in a laminate with improved tensile properties and improved laminate elongation. Greater laminate elongation is important because it indicates a tougher material, i.e., one that is able to withstand pulling longer before breaking. The process of the present invention also maintains film integrity throughout the entire bonding procedure.

The lamination process of the present invention requires a pattern roll, an energy source and an anvil roll that is covered with a soft material that deforms under nip pressure but that also has adequate operational life.

Laminate materials produced according to the present invention may be used in personal care absorbent articles and in surgical gowns and drapes and other forms of protective apparel such as lab coats and workwear. Film/nonwoven laminates produced according to the present invention are especially useful in the outer coverings of personal care absorbent articles, particularly diapers.

The foregoing and other features and advantages of the present invention will become apparent from the following detailed description of the presently preferred embodiments, when read in conjunction with the accompanying examples.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a fragmentary perspective view of a film/nonwoven laminate constructed in accordance with the present invention.

FIG. 2 is a schematic side view of the lamination process of the present invention.

FIG. 3 is a partially cut-away top view of an exemplary disposable garment which may utilize the laminate produced according to he present invention.

## DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

The present invention is directed to lamination of breathable film and nonwoven webs using an anvil roll covered with a soft material.

Referring now to the drawings wherein like reference numerals represent the same or equivalent structure and, in particular, to FIG. 1 of the drawings, there is illustrated a film/nonwoven laminate **10** produced according to the present invention. The laminate **10** includes a fibrous nonwoven web **12** and a polymeric film **14** bonded thereto.

The fibrous nonwoven web **12** may be, for example, necked polypropylene spunbond, crimped polypropylene spunbond, bonded carded webs, elastomeric spunbond or meltblown fabrics produced from elastomeric resins. Fibrous nonwoven webs can impart additional properties such as a softer, more cloth-like feel to polymeric film. A more cloth-like feel is particularly advantageous when the film is being used as a barrier layer in, for example, outer covers for personal care absorbent articles, surgical gowns and drapes, lab coats and other forms of protective apparel.

The manufacture of fibrous non-woven webs is known. Such webs may be formed from a number of processes including, but not limited to, spunbonding and meltblowing processes.

Meltblown fibers are fibers formed by extruding a molten thermoplastic material through a plurality of fine, usually circular, capillaries of a meltblowing die as molten threads or filaments into converging high-velocity, usually hot, gas (e.g., air) streams which are flowing in the same direction as the extruded filaments or threads of the molten thermoplastic material so that the extruded filaments or threads are attenuated, i.e., drawn or extended, to reduce their diameter.

The threads or filaments may be attenuated to microfiber diameter which means the threads or filaments have an average diameter not greater than about 75 microns, generally from about 0.5 microns to about 50 microns, and more particularly from about 2 microns to about 40 microns. Thereafter, the meltblown fibers are carried by the high-velocity gas stream and are deposited on a collecting surface to form a web of randomly disbursed meltblown fibers. The meltblown process is well-known and is described in various patents and publications, including NRL Report 4364, "Manufacture of Super-Fine Organic Fibers" by B.A. Wendt, E.L. Boone and D.D. Fluharty; NRL Report 5265, "An Improved Device for the Formation of Super-Fine Thermoplastic Fibers" by K.D. Lawrence, R.T. Lukas and J.A. Young; U.S. Patent No. 3,676,242 to Prentice; and U.S. Patent No. 3,849,241 to Buntin et al. The foregoing references are incorporated herein in by reference in their entirety. Meltblown fibers are microfibers which may be continuous or discontinuous, are generally smaller than 10 microns in average diameter and are generally tacky when deposited onto a collecting surface.

Preferably the fibrous nonwoven web is polypropylene spunbond. Spunbonded fibers are small diameter fibers that are formed by extruding a molten thermoplastic material as filaments from a plurality of fine, usually circular, capillaries of a spinneret with the diameter of the extruded filaments then being rapidly reduced as by, for example, non-eductive or eductive fluid-drawing or other well-known spunbonding mechanisms. The production of spunbonded non-woven webs is illustrated in patents such as, for example, U.S. Patent No. 4,340,563 to Appel et al.; U.S. Patent No. 3,802,817 to Matsuki et al.; U.S. Patent No. 3,692,618 to Dorschner et al; U.S. Patent No. 3,542,615 to Dobo; U.S. Patent No. 3,502,763 to Hartman; U.S. Patent No. 3,502,538 to Peterson; U.S. Patent Nos. 3,341,394 and 3,338,992 to Kinney; U.S. Patent No. 3,276,944 to Levy; and Canadian Patent No. 803,714 to Harmon. The disclosures of these patents are herein incorporated by reference in their entirety.

Spunbonded fibers generally are not tacky when deposited onto a collecting surface. Spunbonded fibers generally are continuous and have average diameters (from a sample of at least 10) larger than 7 microns and, more particularly, from about 10 microns to about 20 microns.

For the film **14** that is laminated to the nonwoven web **12**, a wide variety of thermoplastic films are useful. Such films include, but are not limited to, polypropylene and/or polyethylene-based polyolefins in mono- or coex-execututions. Polypropylene films are preferred for lamination to polypropylene spunbond.

A process for forming polymeric film **14** is shown in FIG. 2 of the drawings. Referring now to that figure, polymeric film **14** is formed from an extrusion film apparatus **20** such as a cast or blown unit. Typically, the apparatus **20** includes an extruder **22**. The polymeric material is prepared in a mixer **24** and directed to the extruder **22**. The film **14** is extruded into a pair of nip rollers **26**, **28** one of which may be patterned so as to impart an embossed pattern to the newly formed film **14**.

From the extrusion film apparatus **20**, film **14** is directed to a film stretching unit **30** such as a machine direction orienter which is commercially available from vendors such as The Marshall and Williams Company of Providence, Rhode Island. Such an apparatus **30** has a plurality of stretching rollers **32** that move at progressively faster speeds relative to the pair disposed before it. These rollers **32** apply an amount of stress and thereby progressively stretch film **14** to a second length in the machine direction of the film, which is the direction of travel of film **14** through the process as shown in FIG. 2. The stretch rollers **32** may be heated for better processing. Film stretching unit **30** may also include rollers (not shown) upstream and/or downstream from the stretch rollers **32** that can be used to preheat the film **14** before orienting it and/or to cool the film **14** after stretching it.

Preferably, the second, or stretched, length is from

about two to about six times, more preferably from about three times to about four times, the original length of the film **14** prior to stretching.

Film **14** is then directed out of stretching unit **30** so that the stress is removed and the film **14** is allowed to relax. Preferably, a permanent elongation length of from about 1.5 times the original length is retained after the stretched film is allowed to relax.

Lamination reinforces and protects the film. During the laminating process, the film **14** is attached to the nonwoven web **12** to form a laminate **10**.

Referring again to FIG. 2, there is also illustrated a side view of the lamination process of the present invention. A conventional fibrous nonwoven web-forming apparatus **40**, such as a pair of spunbond machines, is used to form the fibrous nonwoven web **12**. The long, essentially continuous fibers **42** are deposited onto a forming wire **44** as an unbonded web **46**. The unbonded web **46** is then sent through a pair of bonding rolls **48, 50** to bond the fibers together and increase the tear strength of the resultant web **12**. One or both of the rolls **48, 50** are often heated to aid bonding. Typically, one of the rolls **48, 50** is also patterned so as to impart a discrete bond pattern with a prescribed bond surface area to the web **12**. The other roll is usually a smooth anvil roll, but this roll also may be patterned if desired.

Once the film **14** has been sufficiently stretched and the fibrous nonwoven web **12** has been formed, the two layers are brought together and laminated using thermal point bonding. Thermal point bonding involves passing the film **14** and the fibrous nonwoven web **12** through the nip formed between a pair of rolls **52, 54**. As with the bonding rolls **48, 50** at least one of the laminating rolls is patterned to create a discrete bond pattern upon the resultant laminate **10**. If desired, bonding rolls **48, 50** may be omitted or used for light compaction and the laminating nip between rolls **52, 54** may

serve to simultaneously bond the nonwoven web **12**, as well as form the laminate **10**. Generally, the maximum bond point surface area for a given area of surface on one side of the laminate **10** will not exceed about 50% of the total surface area. Any of a number of discrete bond patterns may be used. Examples are disclosed in U.S. Patent No. 4,041,203 to Brock et al., which is incorporated herein by reference. The pattern roll **52** is a metal roll, preferably steel.

During lamination, the film is oriented against the non-engraved roll **54**, which is also known as the anvil roll. Such orientation assists force distribution and prevents damage to the film during the bonding process.

The anvil roll **54** is also made of metal, again preferably steel. The anvil roll **54**, however, is covered with a soft material that deforms under nip pressure but that also has an adequate operational life. The soft material generally has a surface roughness ($R_a$) of about 5 to about 250. Surface roughness is measured with a surface roughness tester such as, for example, the Surftest 211 produced by MTI Corporation. The soft material must be softer and more conformable than steel, such as rubber. Rubber-containing compounds may also be useful such as, for example, a silicone rubber compound with a Shore-A hardness of about 80-95. Preferably, a sleeve (not shown) slides over the metal anvil roll **54** to provide the soft, conformable surface. The sleeve deforms under the nip pressure of lamination thereby creating a larger area over which a constant nipping force is distributed. This, in turn, results in a lower pressure required for lamination. The pressure used during lamination according to the present invention is from about 170 to about 230 psi, depending on the relative softness of the sleeve covering the anvil roll **54**. The lower pressure, while enough to laminate the incoming film **14** and nonwoven web **12**, eliminates the severe deformation of the nonwoven web **12** that generally occurs during lamination. The resulting laminate **10** also shows improved tensile properties and laminate elongation, thus indicating a tougher

laminate material.

Preferably, the energy source used to assist lamination is infrared heaters. Other sources, such as a hot air knife, may also be used. The temperature on the pattern roll **52** is between about 230°F and about 260°F. The anvil roll **54** picks up heat and runs at about 150°F during steady state processing.

Once the laminate **10** exists, it may be wound up into a roll **58** for subsequent processing. Alternatively, the laminate **10** may continue in line for further processing or conversion.

The process shown in FIG. 2 may also be used to create a three layer laminate. The only modification to the previously described process is to feed a supply **60** of a second fibrous nonwoven web **12a** into the pattern roll **52** and the anvil roll **54** on the side of the film **14** opposite that of the other nonwoven web **12**. One or both of the nonwoven webs **12** and **12a** may be formed directly in line, as illustrated with nonwoven web **12** in FIG. 2. Alternatively, one or both of the nonwoven webs **12** and **12a** may be in the form of a pre-formed roll **62** as illustrated in FIG. 2 by nonwoven web **12a**. In any event, the second nonwoven web **12a** is fed between the nip of the pattern roll **52** and the anvil roll **54** and is laminated to film **14** in the same manner as the first fibrous nonwoven web **12**.

As previously stated, the laminate **10** produced according to the present invention may be used in a wide variety of applications including personal care absorbent articles such as diapers, training pants, incontinence garments, surgical gowns and drapes and protective apparel such as lab coats and other workwear. A disposable garment **70**, in this case a diaper, is shown in FIG. 3. Although a diaper is shown in FIG. 3, it will be understood that use of the laminate **10** produced according to the present invention is not limited to such articles and may also be used in a wide variety of applications. Referring again to FIG. 3, the disposable

garment 70 includes a liquid permeable top sheet or liner 72, a back sheet or outer cover 74 and an absorbent core 76 disposed between and contained by the liner 72 and the outer cover 74. Disposable garment 70 may also include some type of fastening means 78 such as adhesive fastening tapes or mechanical hook and loop type fasteners and stretch region 80.

Laminate 10 may be used to form various portions of disposable garment 70 including, but not limited to, liner 72, outer cover 74 and stretch region 80. Preferably, laminate 10 is used to form the outer cover 74 of disposable garment 70.

The advantages and other characteristics of the present invention are best illustrated by the following examples. It should be understood that the following examples are illustrative and are not limiting.

Two sets of film/spunbond laminates were produced using rubber and steel anvil rolls. The laminates bonded with the rubber anvil roll displayed greater elongation compared to the laminates bonded with the steel anvil roll. An analysis of the resultant laminates by a scanning electron microscope indicated that the increase in elongation in the material laminated with the rubber anvil roll is due to the fact that the spunbond fibers in the area of the bond points in those materials were flattened and indented into the film rather than fused into the film as shown in the samples bonded with the steel anvil roll.

Of course, it should be understood that a wide range of changes and modifications can be made to the embodiments described above. It is, therefore, intended that the foregoing description illustrate rather than limit this invention and that it is the following claims, including all equivalents, that define this invention.

CLAIMS:

1. A process for preparing an improved film/nonwoven laminate comprising the step of bonding together a fibrous nonwoven web and a polymeric film by passing said fibrous nonwoven web and said polymeric film through the nip between two rolls, wherein the surface of one of said rolls is made from a soft material that deforms under nip pressure.

2. The process of claim 1 wherein said surface of said roll made from a soft material that has a surface roughness of about 5 to about 250.

3. The process of claim 1 wherein said soft material is selected from the group consisting of rubber and rubber-containing compounds.

4. A personal care absorbent article comprising a liquid permeable liner and an outer cover with an absorbent core disposed therebetween, wherein said outer cover includes the film made according to claim 3.

5. The personal care absorbent article of claim 4 wherein said article is a diaper.

6. The personal care absorbent article of claim 4 wherein said article is a training pant.

7. The personal care absorbent article of claim 4 wherein said article is an incontinence garment.

8. A personal protective garment comprising a liquid permeable liner and an outer cover, wherein said outer cover includes the film made according to claim 3.

9. The protective garment of claim 8 wherein said article is a lab coat.

10. The protective garment of claim 8 wherein said article is protective workwear.

11. A process for producing an improved film/nonwoven laminate comprising the steps of:

forming a fibrous nonwoven web;

providing a polymeric film having an original length and capable of having a room temperature stretch length that is at least about two times said original length and an immediate release length essentially equal to said original length;

stretching said polymeric film to form a film having a second length;

allowing said film to relax, thereby producing a film having a third length; and

passing said fibrous nonwoven web and said polymeric film through the nip between two rolls, wherein one of said rolls is covered with rubber or a rubber-containing compound such that the surface of said roll is smooth.

12. The process of claim 11 wherein said fibrous nonwoven web is selected from the group consisting of necked polypropylene spunbond, crimped polypropylene spunbond, bonded carded webs, elastomeric spunbond and meltblown fabrics produced from elastomeric resins.

13. The process of claim 12 wherein said fibrous nonwoven web is spunbond polypropylene.

14. The process of claim 11 wherein said polymeric film is selected from the group consisting of polypropylene and/or polyethylene-based polyolefins.

15. The process of claim 14 wherein said polymeric film is a polypropylene film.

16. A process for producing an improved film/nonwoven

laminate comprising the steps of:

forming a fibrous nonwoven web;

providing a polymeric film having an original length and capable of having a room temperature stretch length that is at least about two times said original length and an immediate release length essentially equal to said original length;

stretching said polymeric film by applying an amount of stress to produce a film having a second length that is from about two times to about six times said first length;

removing said amount of stress from said polymeric film to produce a film having a third length that is about 1.5 times said first length; and

passing said fibrous nonwoven web and said polymeric film through the nip between two rolls, one of said rolls in contact with said polymeric film having a smooth surface, wherein said surface of said roll is made from a soft material that deforms under nip pressure.

17. The process of claim 16 wherein said soft material has a surface roughness of about 5 to about 250.

18. The process of claim 16 wherein said soft material is rubber or a rubber-containing compound.

19. The process of claim 18 wherein the second length is from about three times to about four times said original length.

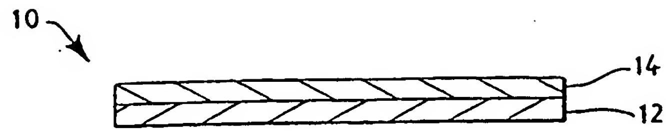


FIG. 1

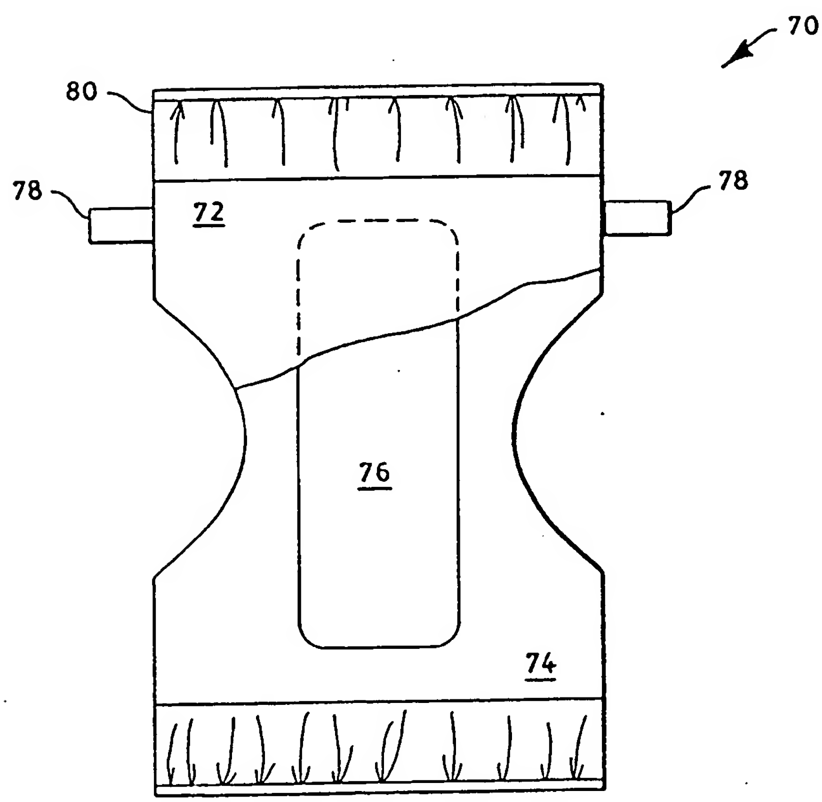


FIG. 3

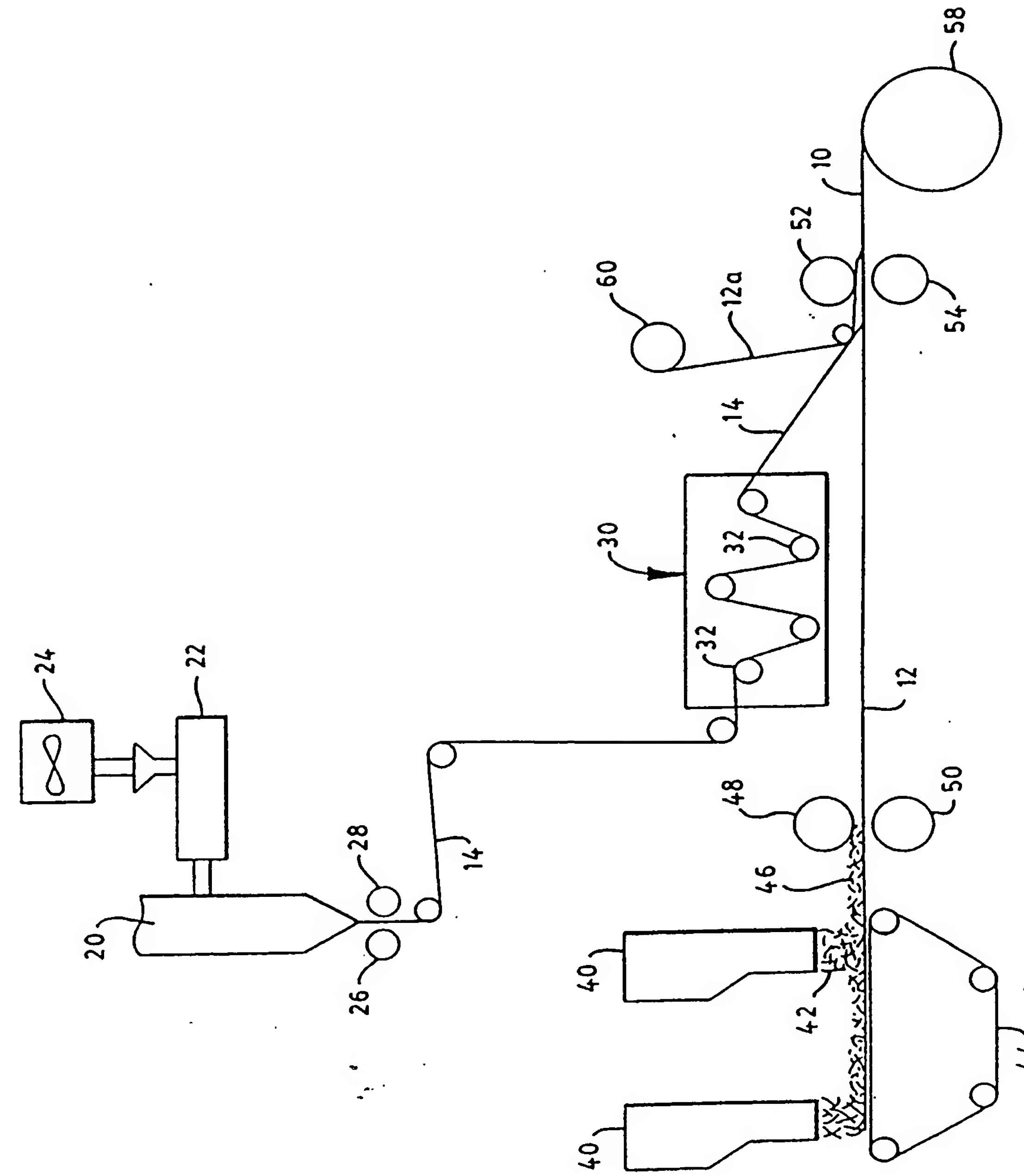


FIG. 2

# INTERNATIONAL SEARCH REPORT

International Application No
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**A. CLASSIFICATION OF SUBJECT MATTER**
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According to International Patent Classification (IPC) or to both national classification and IPC

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Minimum documentation searched (classification system followed by classification symbols)
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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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[X] Further documents are listed in the continuation of box C.

[X] Patent family members are listed in annex.

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| Name and mailing address of the ISA | Authorized officer |
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Intern nal Application No
PCT/US 97/23145

C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family members

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